#1- Intrinsic semiconductor like Silicon or Germanium are doped with p or n type dopants. Identify the dopants and semiconductors below with a check. $\text{Si}_{14}$ and $\text{Ge}_{32}$ are called intrinsic semiconductors.

<table>
<thead>
<tr>
<th>Element</th>
<th>Electron Structure</th>
<th>n-type</th>
<th>p-type</th>
<th>Intrinsic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{B}_{5}$</td>
<td>(He)$_2$s$^2$ 2p$^1$</td>
<td></td>
<td>$\times$</td>
<td></td>
</tr>
<tr>
<td>$\text{Al}_{13}$</td>
<td>(Ne)$_3$s$^2$ 3p$^1$</td>
<td></td>
<td></td>
<td>$\times$</td>
</tr>
<tr>
<td>$\text{Si}_{14}$</td>
<td>(Ne)$_3$s$^2$ 3p$^2$</td>
<td></td>
<td></td>
<td>$\times$</td>
</tr>
<tr>
<td>$\text{P}_{15}$</td>
<td>(Ne)$_3$s$^2$ 3p$^3$</td>
<td></td>
<td>$\times$</td>
<td></td>
</tr>
<tr>
<td>$\text{Ga}_{31}$</td>
<td>(Ar)$_3$d$^{10}$ 4s$^2$ 4p$^1$</td>
<td></td>
<td></td>
<td>$\times$</td>
</tr>
<tr>
<td>$\text{Ge}_{32}$</td>
<td>(Ar)$_3$d$^{10}$ 4s$^2$ 4p$^2$</td>
<td></td>
<td></td>
<td>$\times$</td>
</tr>
<tr>
<td>$\text{As}_{33}$</td>
<td>(Ar)$_3$d$^{10}$ 4s$^2$ 4p$^3$</td>
<td></td>
<td></td>
<td>$\times$</td>
</tr>
<tr>
<td>$\text{In}_{49}$</td>
<td>(Kr)$_4$d$^{10}$ 5s$^2$ 5p$^1$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#2- Sketch Vout for the diode circuits through one sine-wave cycle. Carefully label the voltage axis.

![Diode Circuit Diagrams](image-url)
In this configuration the resistance meter reads a HIGH or LOW resistance for the diode? Explain.

LOW - The diode is forward biased so a small resistance to current flow!

**#3-**

![Diode Configuration Diagram]

**#4-** We are using the 120VAC @ 60Hz wall outlet and step-down transformer to make a 12V AC-to-DC converter. What is the approximate transformer ratio (Ns/Np) needed. In order to keep the ripple at or below 1% with a 1kΩ load what size capacitor is needed?

\[
N_1/N_2 = V_1/V_2 = 120\text{VRM} \times 1.414 / 12\text{V} = \sim 14 / 1
\]

\[
\Delta V = (.01) 12\text{V} = 0.12 \text{V}
\]

\[
i = 12\text{V} / 1000\Omega = 0.012 \text{A}
\]

\[
\Delta V = i / C \text{f} \rightarrow C = i / \Delta V \text{f} \rightarrow C = (0.012) / (0.12) \times 60 = 0.00167 \text{F}
\]
#5- Design a common emitter transistor amplifier with gain of -100 and input impedance of 10KΩ using an npn transistor β= 100.

<table>
<thead>
<tr>
<th>Vcc</th>
<th>RC</th>
<th>RE</th>
<th>R1</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>+24V</td>
<td>10KΩ</td>
<td>100Ω</td>
<td>32Ω</td>
<td>1kΩ</td>
</tr>
</tbody>
</table>

Vcc= 24 V Choose VC = midrange = 12V

Rin = 10K = βRE \( \rightarrow \) RE = 100Ω

Gain = -RC/RE \( \rightarrow \) RC = 10KΩ

iC = (Vcc – VC)/ RC = (24-12)/ 10000 = 1.2 ma

VE =IE RE ~ IC RE = (.0012)(100) = 0.12 V

VB = VE + 0.6 V = 0.72 V

Let R2 = 10 RE = 1kΩ

i2 = VB/R2 = (0.72/1000) = 0.72 mA

iB = iC/β = 0.72/100 mA =0.0072 mA

i1 = iB + i2 = (0.72 + .007) = 0.73 mA

R1 = (Vcc-VB)/ i1 = (24 – 0.72)/0.73e-3 = 32 kΩ
#6- What is the output of this circuit? Vout = __________+8000V

V1 = \(-10\)(100/100) - 5(100/10) - 1(100/5) = -80V

Vout = \(-(-80V)(1000/10)\) = 8000 V

#7- The frequency response of an operational amplifier is most dependent on what factor(s)? Explain.

Shunting capacitance on the chip cause a high frequency cut-off explained by the $X_c = \frac{1}{\omega C}$ AC impedance.

What is the gain of this op-amp at $f = 10$K Hz? At what frequency does the op-amp drop to half its gain?

Gain(10KHz) = __________15.8__________

$f_{1/2} = __________1$MHz__________

\[
\text{db} = 20 \log(V_{out}/V_{in})
\]

\[
\text{gain} = 10^\left(\frac{24\text{db}}{20}\right) = 10^{1.2} = 15.8
\]

\[
\text{db} = 20 \log(15.8/2) = 17.9 \text{ db @ 1}$MHz$